Design of Formula One Racing Car

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Abstract- A modern Formula One (F1) Racing Car has almost as much in common with an aircraft as it does with an ordinary road car. Aerodynamics has become a key to success in the sport and teams spend millions of dollars on research and development in the field each year for improving performance. The aerodynamic designer has two primary concerns :

i. the creation of downforce, to help push the car's tyres onto the track and improve cornering forces,

ii. to minimise the drag that occurs due to turbulence and acts to slow down the car.

In this paper, a Formula One race car is introduced using the AUTOCAD software. All the dimensions are based on the standards laid down by the FIA (Fédération Internationale de l'Automobile). The car design will be enhanced to streamline the flow over the car. Various parts that will be designed include the wheels, front and rear airfoils, front and rear wings, car body chassis, among other subassemblies. A driver will also be placed in a typical driving position inside the car.

Keywords- F-1 car, Airfoil, Autocad, drag, lift, model, speed, Ferrari, cyclinder.

I. INTRODUCTION

On the surface, automobile racing appears simply as a popular sport. But in reality, racing serves as a proving ground for new technology and a battlefield for the giants of automobile industry.

One of the most important aspects of Formula One (F1) car design is aerodynamics. Creating down force, to hold the car to the ground to improve cornering; and minimizing drag, which slows the car down are two primary concerns when designing the car.

Disrupted air flow can cause turbulence, which will produce drag to slow the car. F1 cars often have small 'winglets' before the rear wing, which 'clean up' complex air flow in order to maximize down force. The scope of this project includes :

i. Designing of F1 three-dimensional CAD model using AUTOCAD software.

A. History

The Formula One (F1) World Championship is the highest class of single-seat auto racing in the world. It is sanctioned by the FIA (Fédération Internationale de l'Automobile). Formula One cars can reach speeds upto 330 km/h. The FIA controls and regulates all the sizes and dimensions of Formula One car. These strict regulations led to similarly-dimensioned cars. A typical car will be 463cm long, 180cm wide and 95cm high.

B. Ferrari F10 Background
The Ferrari F10 is built by Scuderia Ferrari Marlbolo.

1) Specifications_:

Chassis: Carbon fiber and honeycomb composite structure
Gearbox: Ferrari 7-speed (+reverse) longitudinal gearbox
Differential & gearbox: Limited slip differential,
Semi-automatic sequential electronically controlled gearbox
Brakes: Ventilated carbon fibre disc brakes

Suspension: Independent suspension, push rod activated torsion springs, front and rear

2) Engine : Engine: type 056 Cylinders: V8 90°

Cylinder Block: Cast Aluminium

Number of Valves: 32, Pneumatic Distribution Total Displacement: 2398 Cm^3
Piston Bore: 98 Mm Weight: 95 Kg

Injection: Magneti Marelli Digital Electronic Injection Iginition: Magneti
Marelli Static Electronic Ignition Fuel: Shell V-Power Lubricant: Shell Helix
Ultra

3) Dimensions :
Wheelbase: 3050mm
Front Track: 1470mm
Rear Track: 1405mm
Overall Length: 4545mm
Overall Height: 959mm
Overall Width: 1796mm
Overall Weight: 600kg,
including driver and camera
Wheels, Front And Rear: 13

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C. Aerodynamics Background

Aerodynamics is a branch of dynamics concerned with studying the motion of air, particularly when it interacts with a moving object. Aerodynamics is a subfield of fluid dynamics and gas dynamics, with much theory shared between them. It is often used synonymously with gas dynamics, with the difference being that gas dynamics applies to all gases.

Understanding the motion of air (often called a flow field) around an object enables the calculation of forces and moments acting on the object. Typical properties calculated for a flow field include velocity, pressure, density and temperature as a function of position and time. By defining a control volume around the flow field, equations for the conservation of mass, momentum, and energy can be defined and used to solve for the properties.

Aerodynamics has become key to success in the Formula One sport and spends of millions of dollars on research and development in the field each year. The aerodynamic design has two primary concerns.

i. The creation of downforce to help push the car's tires onto the track and improve the cornering force.

ii. To minimizing the drag that caused by turbulence and act to slow the car down.

The drag over a body can be minimized by streamlining it (smooth exterior surface). As a result, there will be potential improvements in fuel economy. *[Fig.4 & 5]*

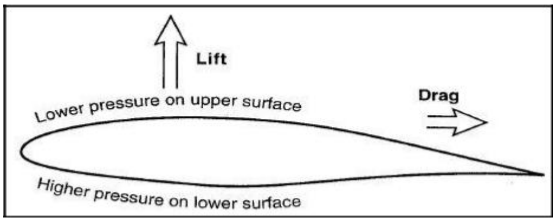

Fig. 1 Flow Over A Streamlined Body

(Courtesy of Race Care Aerodynamics – By Joseph Katz)

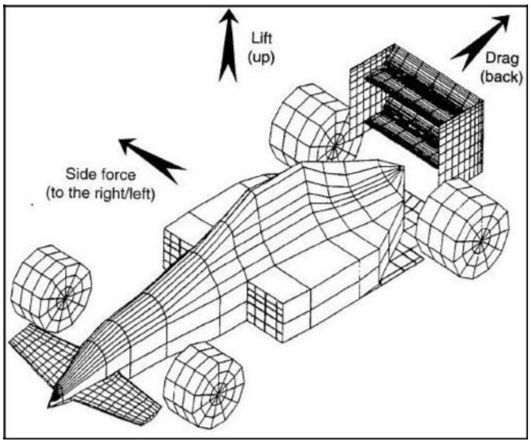

Fig. 2 Aerodynamics forces

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Our specification :

OVERALL LENGTH = 4545mm
OVERALL WIDTH = 1800.06 mm
TOTAL HEIGHT = 959mm
REAR TRACK = 1405mm
FRONT TRACK = 1470mm
WHEEL WIDTH = 330.2mm
WHEELBASE = 3069.8 mm

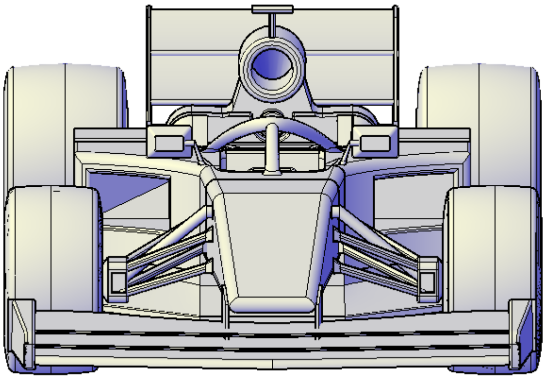

Fig. 3 Front view

Final render :

III. FUTURE PLANS

- Computational Fluid Flow and Structural Analysis of Front wing airfoil NACA 4412.
- Computational Fluid Flow and Structural Analysis of Rear wing airfoil NACA 2408.
- Computational Fluid Flow and Structural Analysis of Front Wing Assembly.
- Computational Fluid Flow and Structural Analysis of Rear Wing Assembly.
- Computational Fluid Flow and Structural Analysis of the entire car model.

[Validations will be based on Zero AOA results]

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